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FLOOD INSURANCE STUDY

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CITY OF GLYNDON, MINNESOTA

CLAY COUNTY

SEPTEMBER 2, 1980

federal emergency management agency

federal insurance administration

COMMUNITY NUMBER - 270083

FEMA-209

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Unnamed Creek Panel 01P

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PUBLISHED SEPARATELY:

Flood Insurance Rate Map

FLOOD INSURANCE STUDY

CITY OF GLYNDON,
CLAY COUNTY, MINNESOTA

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the City of Glyndon, Clay County, Minnesota, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study will be used to convert the City of Glyndon to the regular program of flood insurance by the Federal Insurance Administration (FIA). Local and regional planners will use this study in their efforts to promote sound flood plain management.

In some states or communities, flood plain management criteria or regulations may exist that are more restrictive or comprehensive than those on which these Federally-supported studies are based. These criteria take precedence over the minimum Federal criteria for purposes of regulating development in the flood plain, as set forth in the Code of Federal Regulations at 44 CFR 60.1 (d). In such cases, however, it shall be understood that the state (or other jurisdictional agency) shall be able to explain these requirements and criteria.

1.2 Authority and Acknowledgements

The source of authority for this Flood Insurance Study is the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study were performed by McCombs-Knutson Associates, Inc. for the Federal Insurance Administration, under Contract No. H-4707. This study was completed in August 1979.

1.3 Coordination

Streams requiring detailed study were identified at a meeting attended by representatives of the Study Contractor, the FIA, the Minnesota Department of Natural Resources (MDNR), and the City of Glyndon in March 1978. Other meetings with local residents and city officials were held in August 1978 and March 1979 to obtain information relating to high water marks, past flood history and city maps.

Results of the hydrologic analysis were coordinated with the U.S. Army Corps of Engineers (COE), the MDNR, the Soil Conservation Service (SCS), and the U.S. Geological Survey (USGS).

A meeting was held in June 1979 between city officials, the MDNR, and the Study Contractor to discuss the selection of a floodway in the detailed study area.

On March 20, 1980, the results of the work by the Study Contractor were reviewed and accepted at a final coordination meeting attended by representatives of FIA, the Study Contractor, and the City of Glyndon.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated areas of the City of Glyndon. The area of study is shown on the Vicinity Map (Figure 1).

The areas studied by detailed methods were selected with priority given to all known flood hazard areas, and areas of projected development or proposed construction through August 1984.

Approximate methods of analysis were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to and agreed upon by the FIA and the City of Glyndon.

The Unnamed Creek was studied by detailed methods within the corporate limits. It extends from the southern corporate limit, 7,500 feet northwest to Interstate Highway 10 at the western corporate limit. The ponding area between the Burlington Northern Railroad and Third Street on the east side of Glyndon was studied by approximate methods.

2.2 Community Description

The City of Glyndon, located in west-central Minnesota, in the central part of Clay County, eight miles east of the City of Moorhead is totally surrounded by unincorporated Clay County. It had a population of 831 as of July 1976 (Reference 1).

The climate in this area is dry continental, with extreme seasonal variations in temperature from -50 degrees Fahrenheit (F.) in the winter to 115 degrees F. in the summer. The average annual temperature is about 41 degrees F., and the average annual precipitation is about 22 inches (References 2 and 3).

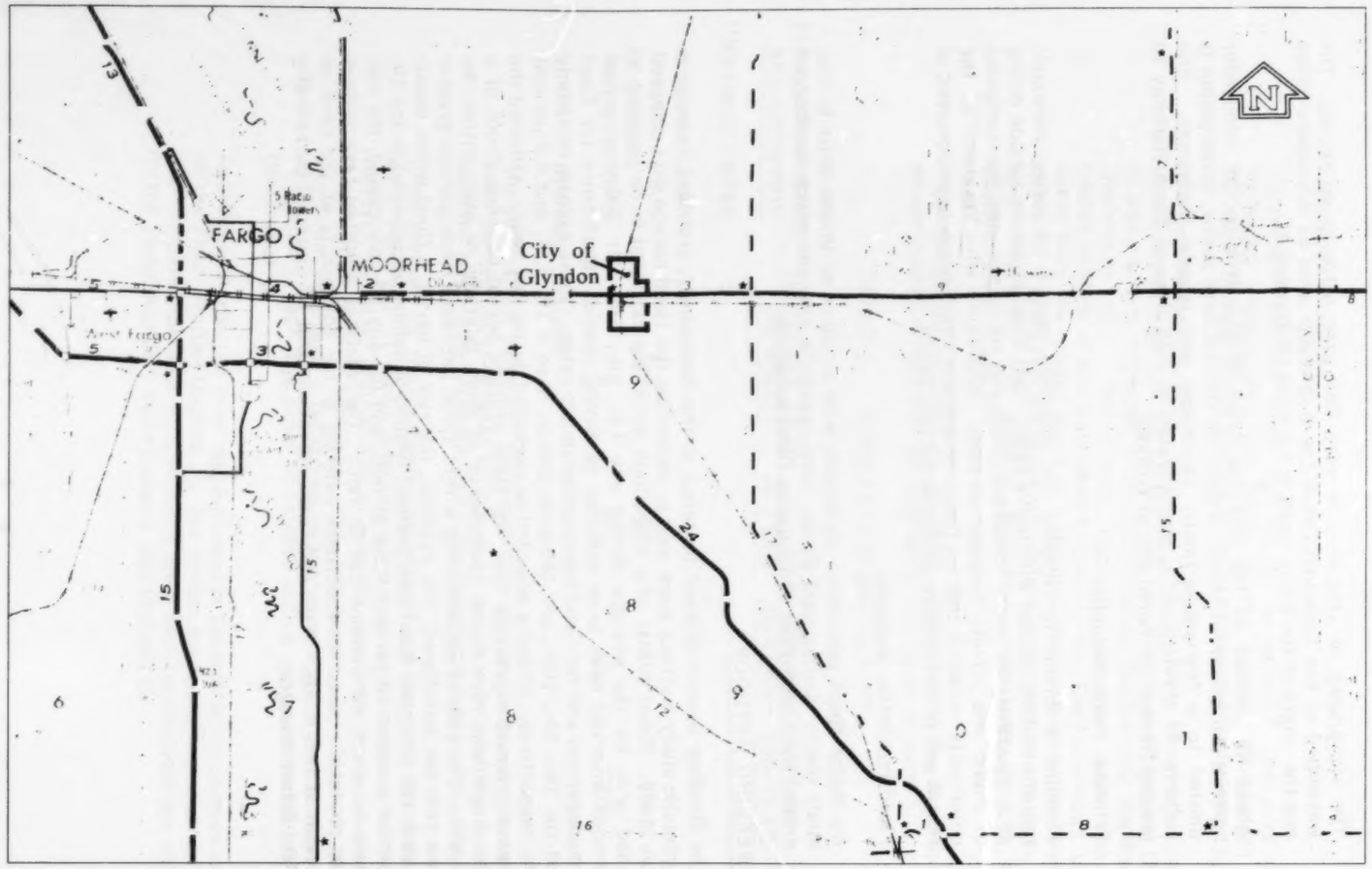


FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

CITY OF GLYNDON, MN
(CLAY CO.)

VICINITY MAP

The topography of this area is very flat with little or no relief. The watershed of the Unnamed Creek has a drainage area of 4.5 square miles and the length of the study reach is 1.8 miles (Reference 4).

About 40 percent of the city has been developed with the remainder agricultural or vacant lands. Within the studied flood plains, development is limited to a few single-family residences and private businesses. The majority of development is concentrated on both sides of Trunk Highway 10 passing through the north side of Glyndon.

2.3 Principal Flood Problems

Flooding problems in Glyndon are primarily caused by spring snowmelt runoff events combined with heavy rains. Past flood problems include debris accumulations, ice jams, inundated roads and structures, and the disruption of public and private business service. Interviews with residents of the community revealed that no floods of historic significance have occurred in recent and no records are available for past floods.

2.4 Flood Protection Measures

No major flood protection structures such as dikes or levees exist in this study reach. During past floods, local residents near the creek sandbagged around their properties to minimize flood damages.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equalled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for flood plain management and for flood insurance premium rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 percent chance, respectively, of being equalled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than one year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (one percent chance of annual occurrence) in any 50-year period is about 40 percent (four in ten), and for any 90-year period, the risk increases to about 60 percent (six in ten). The analyses reported here reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for floods of the selected recurrence intervals for each flooding source studied in detail affecting the community.

The discharge-frequency data for the studied Unnamed Creek were developed through the use of the SCS TR-20 computer program (Reference 5) and methods described in the SCS National Engineering Handbook No. 4 (Reference 6). The TR-20 computer program uses the physical characteristics of the watershed to predict the flood discharge that would occur from the rainfall event of a selected frequency of occurrence. Runoff depth for a given rainfall depth was determined based on soil type, land use, land treatment and general hydrologic conditions in the watershed (References 4, 7, and 8).

Peak discharges for the 10-, 50-, 100-, and 500-year floods of the flooding source studied in detail in the community are shown in Table 1.

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (SQ MILES)	PEAK DISCHARGE (CFS) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
UNNAMED CREEK					
At downstream corporate limits	4.5	250	415	510	740
At upstream corporate limits	3.6	215	335	440	635

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of the streams in the community were carried out to provide estimates of the elevations of the floods of the selected recurrence intervals along the flooding source studied in detail.

Cross sections for the backwater analyses of the Unnamed Creek in Glyndon were surveyed at close intervals upstream and downstream of bridges, culverts, and other obstructions to compute significant backwater effects of these structures. Additional cross sections were located to reflect significant variations in the stream valley topography, and were obtained from topographic maps at a scale of 1:24000 with a contour interval of five feet (Reference 4).

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross section locations are also shown on the Flood Boundary and Floodway Map (Exhibit 2).

Channel and overbanks roughness factors (Manning's "n") used in the hydraulic computations were chosen based on engineering judgment and on a combination of field observations of the flood plain area and aerial photographs of the studied stream (Reference 8). Roughness factors for the channel of the above creek range from 0.033 to 0.066 with overbank roughness factors ranging from 0.035 to 0.20.

Starting water-surface elevations for this Unnamed Creek were calculated using the slope-area method. Water-surface elevations of floods of the selected recurrence intervals were computed through the use of the COE HEC-2 step-backwater computer program (Reference 9). Flood profiles were drawn showing computed water-surface elevations to an accuracy of 0.5 for floods of the selected recurrence intervals (Exhibit 1). For the ponding area studied by approximate methods, the boundary of the 100-year flood was developed from the rainfall and storage capacity of this pond and from field inspection of the topography. Flood elevations of the Unnamed Creek can be raised by debris accumulations and ice jams at hydraulic structures.

The hydraulic analyses for this study are based only on the effects of unobstructed flow. The flood elevations as shown on the profiles are, therefore, considered valid only if hydraulic structures, in general, remain unobstructed and if channel and overbank conditions remain essentially the same as ascertained during this study.

All elevations are referenced from National Geodetic Vertical Datum of 1929 (NGVD); elevation reference marks used in the study are shown on the maps.

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program encourages state and local governments to adopt sound flood plain management programs. Therefore, each Flood Insurance Study includes a flood boundary map designed to assist communities in developing sound flood plain management measures.

4.1 Flood Boundaries

In order to provide a national standard without regional discrimination, the 100-year flood has been adopted by the FIA as the base flood for purposes of flood plain management measures. The 500-year flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the boundaries of the 100-year and the 500-year floods have been delineated using the elevations determined at each cross section; between cross sections the boundaries were interpolated using topographic maps at a scale of 1:24000, with a contour interval of five feet (Reference 4) and using additional data from field inspection by engineers in charge of the study. The boundary of approximate study areas were determined from topographic maps (Reference 4) and field inspection.

For the ponding area studied by approximate methods, the boundary of the 100-year flood was developed from rainfall and storage capacity of this pond, and field inspection of the topography.

The boundaries of the 100- and 500-year floods are shown on the Flood Boundary and Floodway Map (Exhibit 2). Small areas within the flood boundaries may lie above the flood elevations and, therefore, not be subject to flooding; owing to lack of detailed topographical information or to limitations of the map scale, such areas are not shown. In cases where the 100-year and the 500-year flood boundaries are close together, only the 100-year boundary has been shown.

4.2 Floodways

Encroachment on flood plains, such as artificial fill, reduces the flood-carrying capacity, increases the flood heights of streams, and increases flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, the concept of a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the area of the 100-year flood is divided into a floodway and a floodway fringe. The floodway is the channel of a stream plus any adjacent flood plain areas that must be kept free of encroachment in order that the 100-year flood may be carried without substantial increases in flood heights. Minimum standards of the FIA limit such increases in flood heights to 1.0 foot, provided that hazardous velocities are not produced. In Minnesota, however, flood plain encroachment is limited by Minnesota Regulations to that which would cause a 0.5 foot increase in flood heights above pre-floodway conditions at any point (Reference 10). Floodways having no more than a 0.5 foot surcharge were delineated for this study.

The floodways presented in this study were computed on the basis of equal conveyance reduction from each side of the flood plain. The results of these computations were tabulated at selected cross sections for each stream segment for which a floodway was computed (Table 2).

As shown on the Flood Boundary and Floodway Map (Exhibit 2), the floodway boundaries were determined at cross sections; between cross sections, the boundaries were interpolated. In cases where the boundaries of the floodway and the 100-year flood are either close together or collinear, only the floodway boundary has been shown.

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION		
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC.)	WITH FLOODWAY (NGVD)	WITHOUT FLOODWAY (NGVD)	DIFFERENCE
UNNAMED CREEK							
A	150	44	185	2.8	915.7	915.7	0.0
B	1400	51	141	3.6	916.2	916.2	0.0
C	2990	99	219	2.2	917.3	917.1	0.2
D	3795	109	286	1.7	917.8	917.7	0.1
E	4080	71	220	2.2	918.0	917.9	0.1
F	4305	60	210	2.2	918.3	918.1	0.2
G	4505	75	277	1.7	918.5	918.1	0.4
H	4905	45	166	2.8	918.8	918.4	0.4
I	5105	75	221	2.1	919.5	919.4	0.1
J	5270	42	176	2.6	919.9	919.9	0.0
K	5670	182	465	1.0	920.2	920.1	0.1
L	6480	167	358	1.3	920.3	920.2	0.1
M	7355	114	259	1.7	920.6	920.6	0.0

[1] FEET ABOVE CORPORATE LIMITS

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration
CITY OF GLYNDON, MN
(CLAY CO.)

FLOODWAY DATA

UNNAMED CREEK

The area between the floodway and the boundary of the 100-year flood is termed the floodway fringe. The floodway fringe thus encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood more than 0.5 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 2.

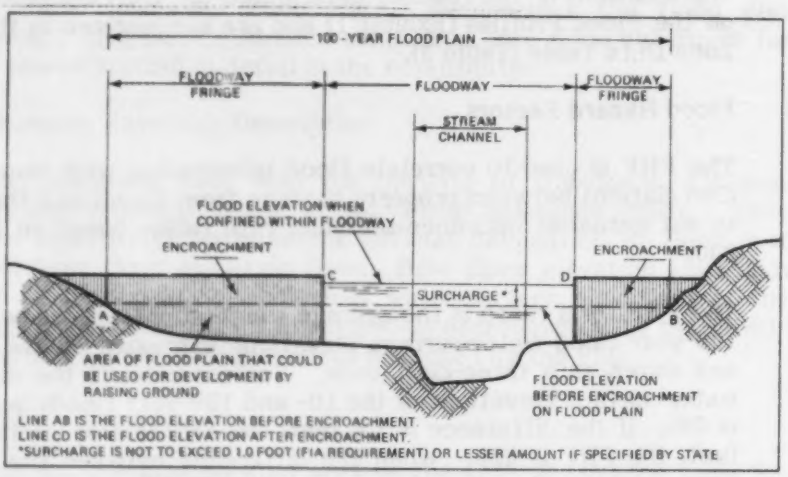

100-YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE *
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE AB IS THE FLOOD ELEVATION BEFORE ENCROACHMENT
LINE CD IS THE FLOOD ELEVATION AFTER ENCROACHMENT
*SURCHARGE IS NOT TO EXCEED 1.0 FOOT (FIA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE

FIGURE 2 - Floodway Schematic

5.0 INSURANCE APPLICATION

In order to establish actuarial insurance rates, the FIA has developed a process to transform the data from the engineering study into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors (FHF), and flood insurance zone designations for each flooding source affecting the City of Glyndon.

5.1 Reach Determinations

Reaches are defined as lengths of watercourses having relatively the same flood hazard, based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. This difference does not have a variation greater than that indicated in the following table for more than 20 percent of the reach.

Average Difference Between 10- and 100-year Floods	Variation
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 foot
7.1 to 12 feet	2.0 feet
More than 12 feet	3.0 feet

The locations of the reaches determined for the City of Glyndon are shown on the Flood Profiles (Exhibit 1) and are summarized in the Flood Insurance Zone Data Table (Table 3).

5.2 Flood Hazard Factors

The FHF is used to correlate flood information with insurance rate tables. Correlations between property damage from floods and their FHFs are used to set actuarial insurance premium rate tables based on FHFs from 005 to 200.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations expressed to the nearest 0.5 foot, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year water-surface elevations is greater than 10.0 feet, accuracy for the FHF is to the nearest foot.

5.3 Flood Insurance Zones

After the determination of reaches and their respective FHFs, the entire incorporated area of the City of Glyndon was divided into zones, each having a specific flood potential or hazard. Each zone was assigned one of the following flood insurance zone designations:

Zones A2, A3: Special Flood Hazard Areas inundated by the 100-year flood, determined by detailed methods; base flood elevations are shown, and zones subdivided according to FHF.

Zone B: Areas between the Special Flood Hazard Area and the limits of the 500-year flood, including areas of the 500-year flood plain that are protected from the 100-year flood by dike, levee, or other water control structure; or areas subject to certain types of 100-year shallow flooding

where depths are less than 1.0 foot; and areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided.

Zone C: Areas of minimal flooding.

Table 3, "Flood Insurance Zone Data," summarizes the flood elevation differences, FHFs, flood insurance zones, and base flood elevations for each flooding source studied in detail in the community.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for the City of Glyndon is, for insurance purposes, the principal result of the Flood Insurance Study. This map (published separately) contains the official delineation of flood insurance zones and base flood elevation lines. Base flood elevation lines show the locations of the expected whole-foot water-surface elevations of the base (100-year) flood. This map is developed in accordance with the latest flood insurance map preparation guidelines published by the FIA.

6.0 OTHER STUDIES

No other studies for the incorporated area of the City of Glyndon were found to exist at the time of this report.

A Flood Hazard Boundary Map has been published by the Federal Insurance Administration (Reference 11). The differences between the Flood Hazard Boundary Map and this study are justified due to the more detailed nature of this Flood Insurance Study.

This report either supersedes or is compatible with all previous studies published on streams studied in this report and should be considered authoritative for the purposes of the National Flood Insurance Program.

7.0 LOCATION OF DATA

Survey, hydrologic, hydraulic and other pertinent data used in this study can be obtained by contacting the Insurance and Mitigation Division, Federal Emergency Management Agency, One North Dearborn Street, Chicago, Illinois 60602.

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND			FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION[3] (NGVD)
		10% (10-YEAR)	2% (50-YEAR)	0.2% (500-YEAR)			
UNNAMED CREEK							
REACH 1	0001	–1.3	–0.5	1.1	015	A3	VARIES–SEE MAP
REACH 2	0001	–0.9	–0.3	0.4	010	A2	VARIES–SEE MAP

[1]FLOOD INSURANCE RATE MAP PANEL
[2]WEIGHTED AVERAGE
[3]ROUNDED TO NEAREST FOOT

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration
CITY OF GLYNDON, MN
(CLAY CO.)

FLOOD INSURANCE ZONE DATA

UNNAMED CREEK

8.0 REFERENCES AND BIBLIOGRAPHY

1. U.S. Department of Commerce, Bureau of the Census, P-25 Series Clay County, Minnesota, July 1976.

2. U.S. Geological Survey, Water Resources Investigations 78-132, Open-File Report, Stephanie A. Warne, 1978.

3. Minnesota Department of Conservation, Division of Waters, Bulletin No. 10, Hydrologic Atlas of Minnesota, St. Paul, Minnesota, April 1959.

4. U.S. Geological Survey, 7.5 Minute Series Topographical Maps, Scale 1:24000, Contour Interval five feet: Glyndon North and South, Minnesota, 1964.

5. U.S. Department of Agriculture, Soil Conservation Service, Engineering Division, Central Technical Unit, Technical Release No. 20, Computer Program for Project Formulation Hydrology, 1973.

6. ————————, SCS National Engineering Handbook, Section 4, Hydrology, August 1972.

7. ————————, Soil Map of Clay County, Minnesota, M.D. Jacobson, Moorhead, Minnesota, 1979.

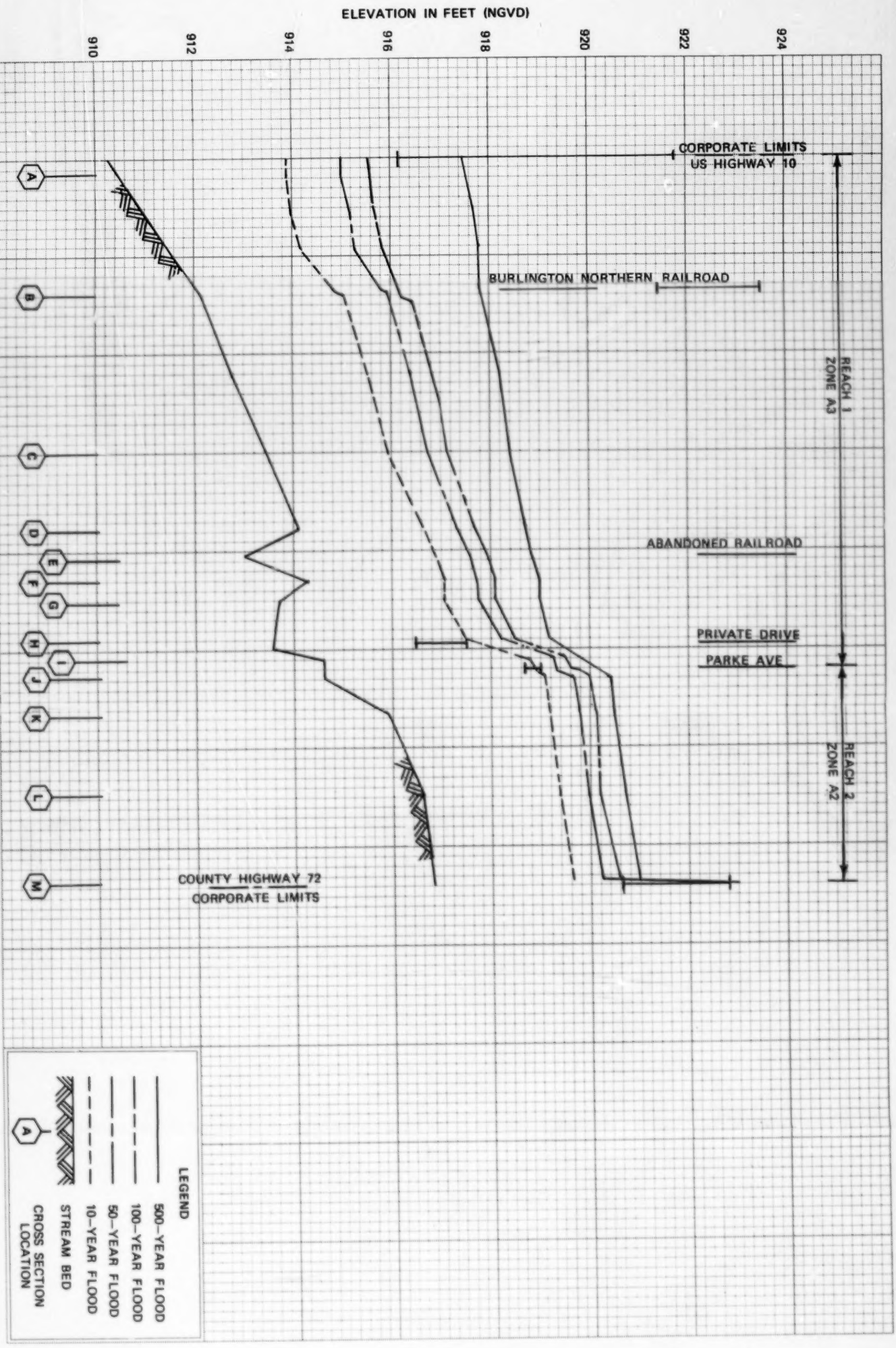
8. ————————, Agricultural Stabilization and Conservation Service, Aerial Photographs, Series A-40, 27027, Numbers 127-130 and 172-53, Scale 1:15840, Glyndon, Minnesota, October 6, 1972.

9. U.S. Army Corps of Engineers, Hydrologic Engineering Center, HEC-2 Water-Surface Profiles, Generalized Computer Program, Davis, California, November 1976.

10. Minnesota Department of Natural Resources, Division of Water, Technical Report No. 6, The Regulatory Floodway in Flood Plain Management, September 1977.

11. U.S. Department of Housing and Urban Development, Federal Insurance Administration, Flood Hazard Boundary Map, City of Glyndon, Minnesota, July 1976.

King, H.W. and E.F. Brater, Handbook of Hydraulics, 6th edition. McGraw-Hill Book Company, Inc., 1976.



01P	FEDERAL EMERGENCY MANAGEMENT AGENCY Federal Insurance Administration **CITY OF GLYNDON, MN** (CLAY CO.)	**FLOOD PROFILES** **UNNAMED CREEK**